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THE ARCTOPSYCHIDAE OF CONTINENTAL AMERICA NORTH OF MEXICO (TRICHOPTERA)

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We are pleased to present herein descriptions and illustrations of the North American species of Arctopsychidae in the adult condition, and to add to the knowledge of Trichoptera the first arctopsychid larval and pupal diagnoses and figures. The material on imagines is from the senior author's thesis "The Trichoptera of continental America north of Mexico," the text of which is too full for present publication. The larval and pupal discussions are part of the junior author's thesis "Immature North American Trichoptera."

The family rank of Arctopsychidae dates from 1924 when Martynov separated the genera *Arctopsyche* and *Arctopsychodes* from the *Hydropsychidae.* These genera were very distinct from the true hydropsychids in having stout, serrate antennae, a short second segment of the maxillary palpi, rather broad wings of similar form, and peculiar male genitalia. In some ways they resemble philopotamids without ocelli, but many characters show this to be a superficial similarity. The relationship of the Arctopsychidae to the Polycentropodidae is more marked. Certain features of the fore wing venation and of the male genitalia are remarkably similar. However, the lack of a subapical spur on the fore tibia seems to be a reliable character for easily separating these two families.

Arctopsyche was erected in 1868 by M'Lachlan for one Russian species described nine years before by Kolenati. *Arctopsychodes* of Ulmer (1915) is a weak genus separated from *Arctopsyche* on the basis of a minor venational difference in the hind wing. The third genus in the family is *Parapsyche* of Betten (1934), the genitalia of which are quite different from those of the other two genera.

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Arctopsyche contains more than a dozen species, *Arctopsychodes* is monotypic and *Parapsyche* is ditypic. All are large, robust species from the cooler parts of the northern hemisphere. All have hairy eyes, no ocelli, and spur formula 2–4–4. The maxillary palpi are five-segmented, the basal segment short, the second somewhat longer, the next two longer still, the fifth longest of all and distinctly annulated.

The eggs of Arctopsychidae are still unknown. The larvae, here described and illustrated for the first time, are very similar to those of Hydropsychidae but regularly differ in two striking characters. The gills are in bundles on a common stalk, somewhat reminiscent of a partially contracted Hydra. The gula is a rectangular plate completely separating the epicrania and extending from the labium to the occipital foramen. In Hydropsychidae, on the other hand, the gill filaments arise on the sides as well as the apex of the short stalk, and the gula is triangular or crescentic and does not approach the labium, the epicrania being contiguous over most of their ventral margins.

In North America, five species have been recognized, one of them the genotype of Arctopsyche. Both sexes are known in two of these, but the larvae and pupae of only one is as yet definitely associated. Other species of larvae are before us, but their identity is unknown. For the present, we can do no more than indicate their characteristics and differences.

KEY TO THE NORTH AMERICAN ARCTOPSYCHIDAE

1. Adults

1. Eighth ♂ sternite with a convex posterior margin, forming a shelf under the genitalia, which project but little beyond it; gonopods erect, distinctly separated from other genitalic parts except over a small area of attachment; ♀ intermediate tibiae not flattened: *Parapsyche* Betten 2

Eighth sternite in ♂ not as above, the genitalia projecting far beyond it; gonopods not erect, attached over a wide area; ♀ intermediate tibiae flattened: *Arctopsyche* M'Lachlan 3

2[1]. Fore wing discal cell about thrice as long as broad; fore wing not over 10 mm. (♂) or 12 mm. (♀) in length; ♂ tenth tergite furcate; a prominent postero-medial tooth on gonopods, the gonopods concave posteriorly: *Parapsyche apicalis* (Banks)

Fore wing discal cell not more than twice as long as broad; fore wing length over 11 mm. (♂), ♀ still unknown; ♂ tenth tergite not furcate; no tooth on gonopods, which are concave but subcylindrical, curved postero-medially: *Parapsyche elsis* Milne

3^1. Male aedeagus with a prominent, dorsal, subapical, upturned tooth; tines of furcate tenth tergite divergent, rounded apically: *Arctopsyche ladogensis* (Kolenati)

No such median tooth as above; tenth tergite quite different . . 4

4^3. Male aedeagus much swollen subapically; submedian process of ♂ tenth tergite furcate, the outer ramus considerably longer; postantennal setiferous warts pear-shaped, the apex directed forward and mediad: *Arctopsyche irrorata* Banks

Male aedeagus not swollen, the sclerotized portion extending much farther ventrally than dorsally; submedian process of ♂ tenth tergite not furcate; postantennal setiferous warts reniform, the emargination in the antero-medial margin: *Arctopsyche grandis* (Banks)

2. Pupae

But one species is known from this stage; see under *Arctopsyche grandis* (Bks.)

3. Larvae

1. Gills on mesothorax 2

No gills on mesothorax 4

2^1. Metathoracic gill clump double; lateral line gills commence before 4th segment; 7th segment with three separate gill clumps each side below lateral line, only one of which is a member of the lateral series; sclerites lighter colored 3

Metathoracic gill clump single; lateral line gills commence on 4th segment; 7th segment with a single gill clump just below lateral line and a double gill clump farther ventral; sclerites darker colored: Six specimens examined from Jasper National Park, Alta., and Corvallis, Ore.: *Type 2*

3^2. Lateral line gills commence on 2nd segment with a single clump below line: Seventeen specimens examined from Almont, Colo.: *Arctopsyche grandis* (Bks.)

Lateral line gills commence on 3rd segment: Two specimens examined from Cultus L., B. C.: *Type 1a*

4^1. No lateral line gill clumps on 3rd segment; segments 2 to 5 inclusive with three separate ventral gill clumps remote from lateral line: Seventeen specimens examined from Cultus L., B. C.; Glacier, Wash.; Mt. Hood National Forest, Ore.: *Type 3*

A gill clump below lateral line on 3rd segment; only two gill clumps other than lateral line series on segments 2 and 3, these very close together: One specimen examined from Cultus L., B. C.: *Type 4*

Arctopsyche M'Lachlan

Hydropsychidae: Arctopsyche n. gen. for *Aphelocheira ladogensis* Kolenati (1859), haplotype, 1868 M'L. p. 300. Valid genus, 1878 McLachlan p. 377, 1907 Banks p. 48, 1907 Ulmer p. 177, 1934 Betten p. 180, 1938 Ross p. 14.

Arctopsychidae: Arctopsyche (M'L.) type genus, 1924 Martynov p. 98. Valid genus, 1934 Betten p. 180 footnote, 1936 Milne pp. 65, 66.

Species: A. amurensis Martynov, 1934; *composita* Martynov, 1930; *grandis* (Bks.) 1900 (with synonym *A. phryganoides* Banks, 1918); *irrorata* Banks, 1905; *ladogensis* (Kolenati), 1859, genotype, (with synonyms *A. obesa* McLachlan, 1878, and *ramosa* McLachlan, 1878); *lobata* Martynov, 1930; *maculata* Ulmer, 1907; *palpata* Martynov, 1934; *pluviosa* Navás, 1916; *sinensis* Martynov, 1909; *spinifera* Ulmer, 1907. *Distribution:* Northern hemisphere, especially the cooler parts.

Labial palpi nearly half as long as maxillary pair. Outer protibial spur two-thirds length of inner, twice the length of tibial diameter. Mesotibiae with about 20 short, yellow spines; subapical spurs about at tibial midpoint, the outer three and a half times the length of the tibial diameter, three-quarters as long as its mate, one and four-fifths its own length before apicals, slightly longer than outer apical, which is two-thirds as long as inner; first four tarsal longer segments with a number of short, yellow spines below. Metatibiae with about thirty short, yellow spines; subapical spurs subequal, slightly more than thrice as long as tibial diameter, nearly twice their own length before apicals, slightly longer than outer apical, which is one-eighth shorter than its mate. Evidences of retained larval gills mark the sides of the abdomen of most specimens. Genitalia as illustrated. Female protibial spurs twice length of tibial diameter, the mesotibiae and tarsi considerably flattened.

Arctopsyche grandis (Banks)

Hydropsyche grandis n. sp., 1900 Banks p. 258. *Arctopsyche grandis* (Banks), valid species, 1907 Banks p. 48, 1907 Ulmer p. 178, 1934 Betten p. 180, 1936 Milne p. 66, 1938 Ross p. 14.

Arctopsyche phryganoides n. sp., 1918 Banks p. 21. *Arctopsyche phryganoides* Bks.; valid species, 1934 Betten p. 180; synonym to *H. grandis* Bks., 1936 Milne p. 66.

Types: Holotype ♂, paratype ♂ of *Hydropsyche grandis* Banks, "S. W. Colo., 27–VII–1899" in the Museum of Comparative Zoölogy, "Type 11514." Holotype ♀ of *Arctopsyche phryganoides* Banks, "Banff, Alta., 3–VIII" in the same collection, "Type 10074."

Material examined: 34 adults from Alta. (Banff, Calgary, Waterton Lakes), B. C. (Cranbrook, Kaslo, Kerameos, Lillooet, Merritt, Seton Lake, Vancouver), Cal. (Shasta Springs), Colo. (N. Creede, Summit Co., "S. W. Colo."), Idaho (no given place), N. Mex. (Beatty's Cabin), Ore. (Alsea Mt., Stayton), P. Q. (Abitibi Region in northwestern part), Utah (Provo). Flying in months March (1 specimen), April (1), May (5), June (5), July (14) and August (8). The early specimens were from Oregon. Seventeen of the specimens were males.

Four pupae from Colo. (Almont), all June 21, 1934. One was very large (14.0 mm.) and immature, one smaller and immature (12.0 mm.), one very mature but like the preceding two in lacking a complete case and larval sclerites. The fourth specimen, nearly mature, was in an unbroken case containing the remains of the larval skin. The last two specimens measured 11.9 and 12.0 mm. respectively.

Seventeen larvae from Colo. (Almont), 2 commencing pupation when killed Feb. 21, 15 mm. long; 1 same length June 22, 2 pale 10 mm. larvae July 4; 3 darker 15 mm. larvae Aug. 8; 5 dark 20 mm. larvae Aug. 30; and 4 dark 20 mm. larvae Sept. 7; all 1934. The species apparently overwinters in the larval condition, pupates in early spring, emerges predominantly in June and July. Probably two years are taken for a complete life cycle.

Description

Adult: Head grayish brown, posterior warts somewhat elevated, like vertex in having considerable long, whitish yellow hair; upper portion of face with whitish hair, lower portion with sparse, brownish yellow hair; antennae yellow, basal segment with some long, whitish yellow hair; maxillary palpi brownish yellow, basal segment with some long, stout, yellowish hairs internally; labial palpi yellow, nearly half as long as maxillary pair. Pronotal warts brownish yellow, medially with white to yellow hair, laterally with dark brown; pleura and legs yellow. Mesonotum reddish yellow, with a broad, median furrow, otherwise very convex, the summit of each convexity with considerable very short, whitish hair; scutellum pale reddish yellow; pleura and coxae pale reddish yellow, legs otherwise paler yellow; tegulae dark brown with both white and brownish hair; wings brownish yellow, veins slightly darker, membrane grayish, with mixed brown and gray hair, the latter in patches. Metanotum dark grayish brown, pleura and coxae paler, femora yellow, tibiae yellowish white, tarsi yellow; hind wing grayish brown, the membrane with scanty, short, yellowish hair. Abdomen reddish brown, genitalia concolorous in ♂, yellowish in ♀, of form as illustrated.

Pupa: Face and mouth parts with brown and black scattered hairs; labrum wider than long, with numerous dark brown, long bristles laterally and shorter ones anteriorly; vertex with sparse, long, brown hair. Mesonotum and metanotum with sparse, fine, brown hair; coxae and trochanters of all legs with scattered brown and black hairs. Ventral surface of 8th and 9th abdominal segments with long brownish hair; oblique ridge on sclerotized processes of 9th segment ventrally with four long yellow setae; posterior margins of abdominal tergites 4 to 7 inclusive with sparse fine brown hair; sclerites as illustrated. Antennae extend to 9th abdominal segment or slightly beyond. Gills on abdominal sternites only as follows: a row near the lateral line, formed of single clumps on segments 1, 2 and 7, and double clumps on 3 to 6 inclusive; ventrad from these is another series on segments 1 to 7 inclusive, formed of double clumps; on segment two, there is a single clump between the two series of gills; all gills are at the posterior margin of the segments. Pupal case either loosely constructed of longitudinally placed, plant fibers with a few pebbles and seeds and numerous silk threads dangling here and there, or chiefly of pebbles, bulkier, with only a little plant material, the fibers placed longitudinally however.

Larva: A caseless, thysanuriform type, probably found in rapid water. Body whitish brown, the sclerites brown to yellowish brown, with black markings as illustrated. All three thoracic segments with broad shield shaped sclerites dorsally, the prothoracic member splitting into right and left halves at ecdysis, the meso- and metathoracic members breaking on a transverse line of weakness shown by a series of dots in the illustrations. All sclerites edged in black and covered with numerous hairs and bristles. Pleura of thoracic segments with characteristic plates bearing the coxal groove, and a triangular plate loosely attached to anterior margin of epimeron. Prosternum and last two abdominal sternites with weak sclerites, that of the prosternum of characteristic form. A long tuft of black hairs near base of each proleg. The arrangement of the gill filaments in clumps on a stalk, and the form of the gula, are easy characters for separation of this larva from non-arctopsychid types; the gill formula itself must be relied upon for specific distinctions, since the plates seem to be uniform, and variation in the mandible teeth is negligible. The lateral line has a series of single clumps of gills above the line on segments 3 to 6 inclusive, and a similar series below the line on these and the 2nd and 7th segments also. The more lateral ventral series has a gill clump on mesothorax and 7th abdominal, and double clumps on metathorax and segments 1 to 6. The more ventral series is of single clumps on segments 2 to 7 inclusive.

Metamorphotype: One, illustrated, in the Milne collection.
Illustrations: Plates III and IV.

Arctopsyche irrorata Banks

Arctopsyche irrorata n. sp., 1905 Banks p. 217, pl. 2 fig. 26. *A. irrorata* Banks, valid species, 1905 Banks p. 15, 1907 Banks p. 48, 1907 Ulmer, p. 178, 1908 Bks. p. 156, 1934 Betten p. 180, 1936 Milne p. 66.

Type: Holotype ♂ "Black Mts., N. C., VI, Beutenmuller" in the Amer. Mus. Nat. Hist.

Material examined: 2 ♂♂ adults, the type mentioned above, and one in the Milne collection "Sunburst (Haywood Co.), N. C., late V, 1913."

Description

Adult: Indistinguishable from *A. grandis* except in the postantennal setiferous warts and the genitalia, which are described in the key, and illustrated.

Illustrations: Plate IV.

Arctopsyche ladogensis (Kolenati)

Aphelocheira ladogensis n. sp., 1859 Kolenati p. 201, pl. 1 fig. 4. *A. ladogensis* Kol., valid species, 1864 Hagen p. 805. *Arctopsyche ladogensis* (Kol.), genotype, 1868 M'Lachlan p. 301; valid species, 1872 M'L. p. 68, 1878 McLachlan p. 378, 1907 Banks p. 48, 1907 Ulmer p. 178, 1932 Ulmer p. 210, 1934 Betten p. 180, 1936 Milne pp. 66, 67.

Arctopsyche obesa McLachlan nec Hagen, 1878 McLachlan p. 379; *A. obesa* McL., synonym to *Aphelocheira ladogensis* Kol., 1936 Milne p. 67.

Arctopsyche ramosa McLachlan nec Hagen, 1878 McLachlan, p. 379; *A. ramosa* McL., synonym to *Aphelocheira ladogensis* Kol., 1936 Milne p. 67.

Types: Several of *Aphelocheira ladogensis* Kol., from Lake Ladoga and River Neva, North Russia, the specimens distributed to the museums of "Petropoli, Vindobonae Beolini, Hafniae, Holmiae," with at least one retained in the author's collection, now supposedly divided between Leningrad and Prague. Holotype ♂ of *Arctopsyche ramosa* McL. in the Museum of Comparative Zoölogy, "Slave Lake, Hudson's Bay Territory, 1864, Kennicott."

Material examined: 4 ♂♂ adults, including the holotype of *A. ramosa* McL., and a topotype mentioned by McLachlan (1878) as typical ladogensis. Also one from "Mile 412, Hudson Bay Railway, Manitoba, 15–VI–1932," and one from "White Mts., N. H., 1–3: VI."

Description

Adult: Head reddish brown, with brownish white and white hair; basal antennal segment reddish yellow, darker than flagellum; palpi brownish yellow. Prothorax dark reddish brown, coxae reddish yellow, femora somewhat paler, tibiae and tarsi yellow. Mesonotum blackish, scutellum slightly paler with yellowish hair; pleura and coxae dark reddish yellow, legs otherwise paler; tegula brownish with mostly yellowish hair, some brown; wing yellow, too much rubbed in all specimens for comments on vestiture. Metathorax and coxae dark reddish yellow, legs paler, tibiae yellowish white, coxae slightly darker; hind wings yellow, veins concolorous, membrane with short, yellowish brown hair. Abdomen dark brown, genitalia golden.

Illustrations: Plate IV.

Parapsyche Betten

Hydropsychidae: Parapsyche n. gen. for *Arctopsyche apicalis* Banks (1908), haplotype, 1934 Betten p. 181.

Arctopsychidae: Parapsyche (Betten), valid genus, 1936 Milne, pp. 66, 67.

Species: P. apicalis (Banks), 1908 genotype; *elsis* Milne, 1936.

Distribution: North America, especially the cooler parts.

Palpi as in *Arctopsyche.* Outer protibial spur very slim, twice as long as tibial diameter, two-thirds the length of its mate. Mesotibial subapical spurs at tibial midpoint, the outer nearly thrice as long as tibial diameter, three-fifths as long as the inner, subequal to inner apical, which is one-third longer than its mate. Metatibial outer subapical spur slightly shorter than its mate, one and one-half times its own length before apicals, subequal to inner apical, which is one-quarter longer than the outer, four times as long as tibial diameter. No indication of retained larval gills on the abdominal pleura. Female mesotibiae not flattened. Male eighth sternite with a convex projecting posterior margin, forming a shelf under genitalia. This genus is close to *Diplectrona* of Hydropsychidae and may form a connecting link between the two families.

Parapsyche apicalis (Banks)

Arctopsyche apicalis n. sp., 1908 Banks p. 266. *Arctopsyche apicalis* Banks, valid species, 1926 Sibley p. 104, 1926 Betten p. 524 (with note that it should be in a new genus), 1927 Johnson p. 50.

Parapsyche apicalis (Banks), haplotype, 1934 Betten p. 181, pl. 16 figs. 14–18, pl. 17 figs. 1–2. Valid species, 1936 Milne pp. 66, 67.

Types: Holotype ♂, allotype ♂ of *Arctopsyche apicalis* Banks in the Museum of Comparative Zoölogy, "Franconia, N. H." and "Fourth L., Fulton Chain, 12–VII," (N. Y.), respectively, both "Type 11515."

Material examined: 22 adult specimens including the above mentioned types, from Colo. (Manitou), Mass. (no locality given), N. H. (Franconia, Mt. Washington, Glen House, Randolph, White Mts.), N. Y. (Fourth L., Tompkins Co.), N. C. (Nellie), N. S. (Digby), and U. S. A. (no locality). These were taken in June (10 specimens), July (3), August (1) and on unrecorded dates (8). All but two were males.

Description

Adult: Head dark brown, posterior warts elevated, paler, with dark hair; vertex with yellow hair, eminence with a median longitudinal furrow; face with dark hair; eyes rather large; antennae yellowish, basal segment with a little dark hair; palpi brownish. Pronotum mostly covered by brownish yellow warts bearing yellow hairs; pleura and legs brownish yellow. Mesonotum reddish yellow, scutellum concolorous, both with yellowish white hair; pleura and legs yellow; wing base brownish yellow, tegulae with brown hair; wing grayish yellow, with small patches of appressed yellow hair among the dark brown covering. Metanotum pale reddish yellow; pleura and legs yellow, the tibiae whitish; hind wing yellowish gray, vestiture short. Abdomen dark reddish brown, genitalia more yellowish in ♂, concolorous to pale grayish yellow ventral surface of abdomen in ♀.

Illustrations: Plate V.

Parapsyche elsis Milne

Parapsyche elsis n. sp., 1936 Milne pp. 66, 67.

Types: Holotype ♂ "Cultus L., B. C. 8–VII–1934, W. E. Ricker" in the Milne collection. Four ♂ paratypes, 1 in the Museum of Comparative Zoölogy. "Black Mts., N. C., V," 1 in the Canadian National Collection, "Revelstoke, B. C., 14–VII–1931," two in the Milne collection, "Banff, Alta., 5–VII–1922" and "Bellnap Springs, Ore., 23–VI–1930."

Material examined: Only the five male types are known, from Alta., B. C., N. C. and Ore.

Description

Adult: Head yellow, posterior warts concolorous, with brownish yellow hair; face with brown hair; antennae yellow; maxillary palpi brownish yellow, basal segment with some long, yellow, stout hairs; labial palpi very slender, reaching to about midpoint of second segment of maxillary pair. Prothorax yellow, warts concolorous, separated by an abrupt median fissure, each bearing considerable yellowish white hair; legs yellow, tibiae with a few scattered, short, subappressed, yellow spines. Mesonotum brownish yellow, with a broad median furrow, otherwise very convex, the summit of each convexity with considerable, very short, suberect, brown hair; scutellum yellow, with a little similar brownish erect hair; pleura and legs yellow, tibiae and tarsi with a little brownish hair, a few short, subappressed, yellow spines on tibiae; tegulae yellow, with concolorous hair, wing yellowish, veins concolorous, membrane with rather scanty, short, appressed, brownish hair, with many small patches of yellowish scattered among it. Metathorax and legs yellow; hind wings colored as fore pair, the hair on them all brown. Abdomen dark brown above, yellow on sides and below; genitalia yellow.

Illustrations: Plate V.

UNIDENTIFIED LARVAE (see key)

Type 1a: Two specimens from "Reservoir Creek, Cultus L., B. C., 30–V–1935," each 13 mm. long, 2 mm. at the widest. Similar to *Arctopsyche grandis* (Bks.) except for the lack of lateral line gills on the 2nd abdominal segment.

Type 2: Five specimens from "Jasper National Park, Alta., 15–VIII–1936, C. T. Brues," and one from "South Fork, McKenzie River, Ore., 5–IX–1932, R. E. Dimick." The former specimens measure 12 to 20 mm. long, 2 to 3 mm. broad, while the latter specimen measures 21 mm. long, 5 mm. broad.

Type 3: One each from "Luinchin Creek, Cultus L., B. C., 19–V–1935, W. E. Ricker" (20 mm. long, 4 mm. wide), "Reservoir Creek, Cultus L., B. C., 30–V–1935, W. E. Ricker" (21 mm. by 4 mm.), "Canyon Creek, Glacier, Wash., 9–VII–1935, W. E. Ricker" (15 mm. by 2 mm.), and 14 from "Camp Creek, Mt. Hood National Forest, Ore., 2–VIII–1933, R. E. Dimick" (10 to 20 mm. long, 1–3 mm. broad).

Type 4: One specimen from "Luinchin Creek, Cultus L., B. C., 19–V–1935, W. E. Ricker" measuring 10 mm. long, 1.2 mm. broad.

The forty-three larvae studied agree in the following characters, which separate them from Hydropsychidae, Polycentropodidae and Philopotamidae.—A quadrate gula instead of a triangular gula; gills in a Hydra-like clump, not with filaments spread along the side of the stalk as in Hydropsychidae or absent as in the other two families; a triangular plate on the proepimera as in Hydropsychidae, lacking in Philopotamidae and differing in shape from the type found in Polycentropodidae; sclerotized pro-, meso- and metanota as in Hydropsychidae, but not in the other two families.

The four pupae studied agree in having the same type of gill clumps as in the larvae, a character which makes them easy to separate from all other caddis pupae.

Hoplia equina LeConte.—The occurrence of this beetle in very unusual numbers was noticed at Berlin, Mass., on June 29, 1937. By sweeping the grass at the foot of a high embankment on the Wachusett Aqueduct, 148 males and one female were taken in an area about 1000 feet long by 30 feet wide. They were taken about 11 A. M. and many were seen to be near or at the tops of the grass stems, perhaps preparing for flight. Two days later not one specimen could be found in this place though a few males and two females were taken about half a mile away.—C. A. FROST, Framingham, Mass.